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Wetzels, Martinus

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Published in:
Journal of Product Innovation Management

DOI:
[10.1111/jpim.12571](https://doi.org/10.1111/jpim.12571)

Published: 01/03/2021

Document Version
Publisher's PDF, also known as Version of record

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Please cite the original version:
Wetzels, M. (2021). The road ahead is digital for innovation management and there is no way back. *Journal of Product Innovation Management*, 38(2), 245-247. <https://doi.org/10.1111/jpim.12571>

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The road ahead is digital for innovation management and there is no way back

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Editors: Charles H. Noble and Jelena Spanjol

The thought-provoking paper by Cooper (2021) provides a beacon for researchers across disciplines contributing to the domain of innovation management. Cooper (2021) identifies five developments originating from the need for accelerating product development in the COVID-19 pandemic, but he also highlights a root cause which lies at a deeper level of change, viz. digital transformation. Digitalization has increasingly reduced the innovation cycles and accelerated new product development. The current pandemic is acting as a virtual magnifying glass and shows in a micro snapshot what the future has in store for innovation management. Cooper (2021) rightly points out that digital product development will increase the efficiency by 19% and reduce the time-to-market by 17% on average. These statistics are impressive, but even more impressive is the performance of the top 10% digital product champions (PWC, 2019): they increase their efficiency by 31%, reduce their time-to-market by 28%, and their production cost by 20% (13% on average). Digitalization has fundamentally changed the way we innovate by introducing novel digital business models, new smart products and services, emerging digital technologies, and the evolution of the experience economy. How can academic research support this paradigm shift to digital innovation management?

First of all, and maybe most importantly, we need to learn across disciplines. The COVID-19 pandemic has clearly shown us that we need a truly interdisciplinary approach to find solutions to the challenges it has posed to the global community. Numerous disciplines have explored the potential

impact of digital transformation on innovation management, but we still lack an interdisciplinary approach to study phenomena from an integrative perspective to avoid white spots in our field of study. Digital transformation requires the revision of our theories as well as our methods. Our classical methods based on surveys, experiments, and qualitative techniques might only show us part of the phenomena we are studying. Digital transformation has resulted in the availability of large quantities of unstructured data, such as text, images, video, audio, eye-tracking, facial expressions and neuro data, and is growing at an ever-increasing pace (Balducci & Marinova, 2018). It is estimated that unstructured data constitute about 80%–90% of all data worldwide. How can the potential of unstructured data be harnessed for innovation management? Unstructured data requires novel data analytical approaches to extract features for further analysis. For instance, Khanday et al. (2020) show that machine learning can be used to diagnose COVID-19 using clinical text data. However, most of this research still takes place in disciplinary silos and ultimately we will need to integrate these conceptual and empirical insights in order to stimulate truly interdisciplinary research in innovation management.

One of the more popular tools in the digital innovation toolbox is crowdsourcing. More in particular innovation contests, which operate using digital platforms allowing participants to contribute by generating, developing, and discussing ideas. For example, Vermicelli et al. (2021) provide evidence from 16 projects that crowdsourcing can provide novel and effective solutions

The related Catalyst article is available at: <https://doi.org/10.1111/jpim.12565>

Other Commentaries related to this Catalyst are: <https://doi.org/10.1111/jpim.12568>, <https://doi.org/10.1111/jpim.12569>, <https://doi.org/10.1111/jpim.12570>

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for COVID-19 challenges. In order to study how innovation processes evolve during innovation contests we need to take an interdisciplinary perspective. We need to learn how users communicate with each other during innovation contests, typically using textual data, and with whom they communicate at which point in time. In order to realize the potential of this data and these new approaches and theoretical lenses we need to learn from other disciplines, such as information systems, computer science, linguistics, education, and communication. This involves using computational linguistics, natural language processing, and social network analysis to provide additional insights over the use of focus groups and surveys (cf. Ludwig et al., 2014).

Innovation hardly ever takes place in splendid isolation anymore. Quite the contrary, the innovation process involves co-creation by a network of different parties in the innovation process. For example, BioNTech and Pfizer development decided to cooperate early in the development process of their COVID-19 vaccine, the first mRNA vaccine to be authorized for humans. Information can also be obtained from the communication with customers, such as by virtual and human agents. These insights can be complemented by data generated by sensors in smart products and services on the Internet-of-Things. Smart products and services create value to customers as a bundle of cyber-physical arrangements (Raff et al., 2020). Customers need to co-create the data that is necessary to personalize their customer experience over time. In order to provide a personalized customer experience during the touchpoints of the customer journey firms will need data from their customers. Design thinking concepts and tools can be helpful to integrate all this information in a meaningful way (Micheli et al., 2019). For instance, the mobile apps experience fellow (<https://www.experiencefellow.com>) or indeemo (<https://indeemo.com>) allow customers to record the touchpoints across their customer journey. This information is then compiled into dashboard and provides valuable insights for digital innovation management. However, we need to be aware of privacy issues, as customers give up their data for a more personalized customer experience. A key example for the importance of privacy concerns is the development of various COVID-19 mobile tracking apps based on Bluetooth technology.

Teams have been considered the panacea for new product development. However, the underlying mechanisms of teamwork remain under-researched. A team is more than the sum of its members, but the interaction process leading to team performance is not well understood. Video and audio recording of interaction patterns in teams can provide more granular insights by automatic coding of gestures and facial expressions, voice analysis, and transcription of the audio sequences. Using wearables with multiple sensors, such as sociometric badges (Pentland, 2008) might provide complementary insights, as they focus on body movement, speech features, proximity, and face-to-face communication among team members. Virtual innovation teams, and increasingly most teams are virtual in the COVID-19 pandemic, are faced by even more critical challenges. Virtualness

in teams has an almost universally negative impact on team performance and satisfaction. However, for longer-term teams these effects are considerably weaker or even disappear (De Guinea et al., 2012). Especially, dedicated teams have proven invaluable in the development of the COVID-19 vaccine by BioNTech and Pfizer. We need more research at the individual and team level to determine how virtual teams should be composed at different stages of the product development process.

Recently, Rindfleisch et al. (2020) highlighted the importance of new digital technologies for innovation management. However, a content analysis by the same authors showed that actually less than a dozen papers have focused on these new technologies, predominantly covering social media and big data. Digital technologies, such as augmented and virtual reality (AR/VR), artificial intelligence (AI), and blockchain have not received adequate attention in the innovation management community to date. Augmented and virtual reality (AR/VR) shows great promise to provide customers with a virtual prototype of products and services at a relatively low cost and within a short timeframe. Different version of products and services can easily be created and used for testing. For example, 42dp Labs build a virtual store for the German retailer Metro for their new stores in France for testing purposes (<https://www.42dp.com/projects/metro-vr-store/>). In addition, 3D-printing may provide haptic feedback from new products prototypes, while audio and scents could be employed to simulate a multisensory customer experience. Artificial intelligence is developing fast to impact the idea generation and development stages of the innovation process. Artificial intelligence and natural language processing have also been employed to find drug candidates for COVID-19 (Keshavarzi Arshadi et al., 2020). Blockchain technology is an under-researched digital technology in innovation management. Its main applications are currently in finance, for example, cryptocurrencies. Some researchers compare the potential impact of blockchain technology in the upcoming decennium to the advent of the Internet in 1990s (cf., Morabito, 2017). Blockchain might also provide a solution to privacy concerns on social media. For example, Diaspora is a social media platform built on the blockchain principles, which allows users to own their data without revealing their identity. Some blockchain social networks, such as Steemit and Minds, even use cryptocurrency to pay users for contributing to the platform.

The current COVID-19 pandemic has highlighted the ongoing paradigm shift in innovation management. The real challenge for innovation researchers and practitioners alike is to learn from the current pandemic situation for the future of digital innovation management. The key message is: Digital innovation is the future and there is no way back. Interdisciplinary research will no longer be a “nice to have,” but rather a “must have.” Unstructured data, big data, and digital tools, such as crowdsourcing, will show us the road to new insights. Co-creation with customers and other network parties will open new doors

for innovation in the emerging experience economy. Emerging digital technologies will provide new approaches to study and understand phenomena in innovation management.

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Martin Wetzels is professor in marketing and supply chain research at the School of Business and Economics, Maastricht University, the Netherlands. He currently serves as the Scientific Director of the Education Institute at the School of Business and Economics. His main research interests are services marketing, marketing research, B2B marketing, marketing channels, social media, text analytics, visual marketing, AR/VR, and digital marketing. His work has resulted in more than 90 papers in international journals, such as, *MIS Quarterly*, *Journal of Marketing*, *Management Science*, *Journal of Operations Management*, *Journal of Consumer Research*, *Accounting, Organizations and Society*, *Journal of the Academy of Marketing Science*, *Journal of Retailing*, *Journal of Service Research*, *Long Range Planning*, *Industrial Marketing Management*, *Journal of Product Innovation Management*, *Journal of Consumer Psychology*, *Journal of Management Studies*, *Journal of Business Research*, *Psychology and Marketing*, *Marketing Letters*, *European Journal of Marketing*, and *International Journal of Research in Marketing*. He has contributed more than 130 papers to conference proceedings and presentations. His work has received more than 24000 citations on Google Scholar resulting in an h-index of 57 and a g-index of 155. A recent paper in PLOS Biology included him in the top 2% of scientists worldwide according to citation impact. He has supervised more than 25 PhD candidates to completion. Finally, he serves on the editorial review board of 10 leading international journals.

How to cite this article: Wetzels M. The road ahead is digital for innovation management and there is no way back. *J Prod Innov Manag*. 2021;38:245–247. <https://doi.org/10.1111/jpim.12571>